

# Accuracy Characteristics for ZID Risk Reduction Scenario Hours 1900-2100

## 1 Introduction

This document contains scenario characteristics for hours 1900 to 2100 GMT recorded on October 11, 2000 at Indianapolis ARTCC (ZID). Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, and flight plan adherence. Definitions of the provided scenario characteristics are provided in Reference[1].

## 2 Reference

[1] Paglione, M., Oaks, R., Ryan, Dr. H., Summerill, J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

## 3 Center Airspace

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZID Center using the October 5, 2000 ACES chart cycle. Information provided in Table 1 was gathered from running URET PRE and local knowledge.

**Table 1: Center Airspace Characteristics**

Metric	Definitions	Count
Airports	From URET DU Adaptation List	508
Sectors	From URET DU Adaptation List	113
SAA	Special Activities Airspace	15
APDIA	Automated Problem Detection Inhibited Area	20
SID	Standard Instrument Departure	13
STAR	Standard Arrival Route	90
PAR	Preferential Arrival Route	273
PDR	Preferential Departure Route	273
PDAR	Preferential Departure Arrival Route	179

## 4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

### 4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

**Table 2: Count of Current Plan Aircraft Encounters**

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	178	104
$5 \leq d < 10$	246	136
$10 \leq d < 15$	315	155
$15 \leq d < 23$	659	349
$23 \leq d < 30$	503	279
Total	1901	1023

**Table 3: Count of Trial Plan Aircraft Encounters**

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	178	99
$5 \leq d < 10$	246	128
$10 \leq d < 15$	315	147
$15 \leq d < 24$	733	365
$24 \leq d < 30$	429	230
Total	1901	969

## 4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

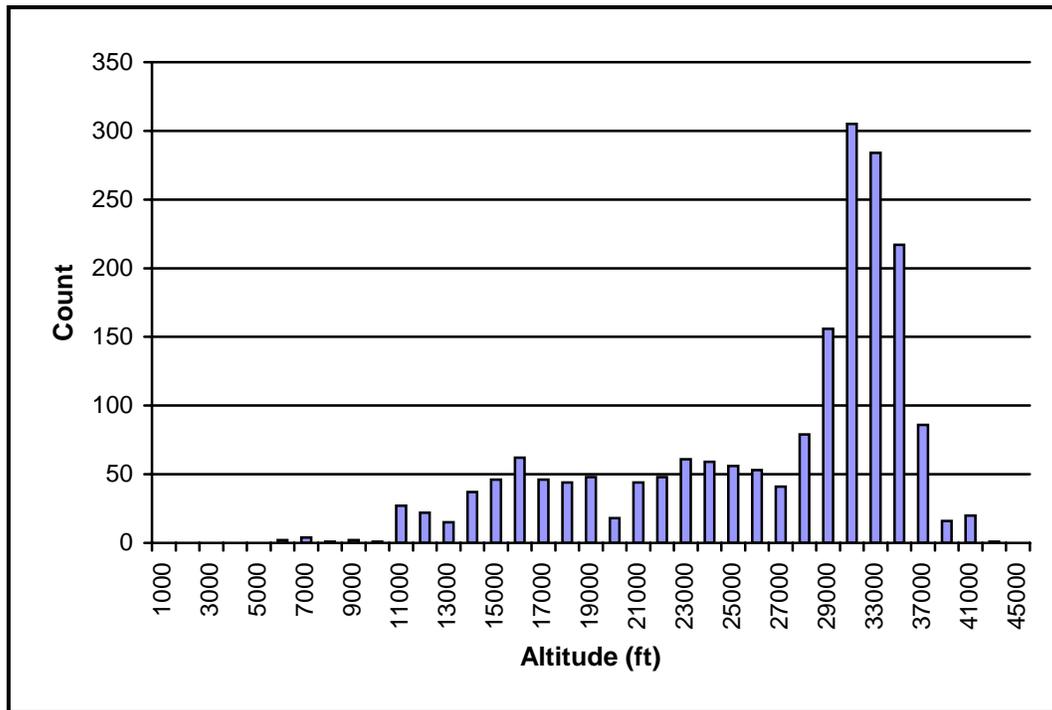


Figure 1: Aircraft to Aircraft Encounters by Altitude

## 4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 4: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	77	82	79	34	272
Descend-Descend	31	8	12	10	61
Climb-Climb	95	35	25	41	196
Cruise-Climb	188	129	157	151	625
Cruise-Descend	122	108	127	128	485
Climb-Descend	69	36	42	74	221
Unknown	27	7	1	6	41
Total	609	405	443	444	1901

## 5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

### 5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

**Table 5: Count of Current Plan Airspace Encounters by Horizontal Separation**

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts <sup>1</sup>	115	86
$d = 0^2$	8	7
$0 < d < 7$	199	159
$7 \leq d < 9$	61	47
$9 \leq d < 11$	65	52
$11 \leq d < 16$	147	111
$16 \leq d < 30$	455	332
Total	1050	794

**Table 6: Count of Trial Plan Airspace Encounters by Horizontal Separation**

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts <sup>3</sup>	115	82
$d = 0^4$	8	6
$0 < d < 8$	230	180
$8 \leq d < 11$	95	74
$11 \leq d < 13$	54	46
$13 \leq d < 19$	164	112
$19 \leq d < 30$	384	278
Total	1050	778

<sup>1</sup> This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

<sup>2</sup> This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

<sup>3</sup> This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

<sup>4</sup> This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

## 5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

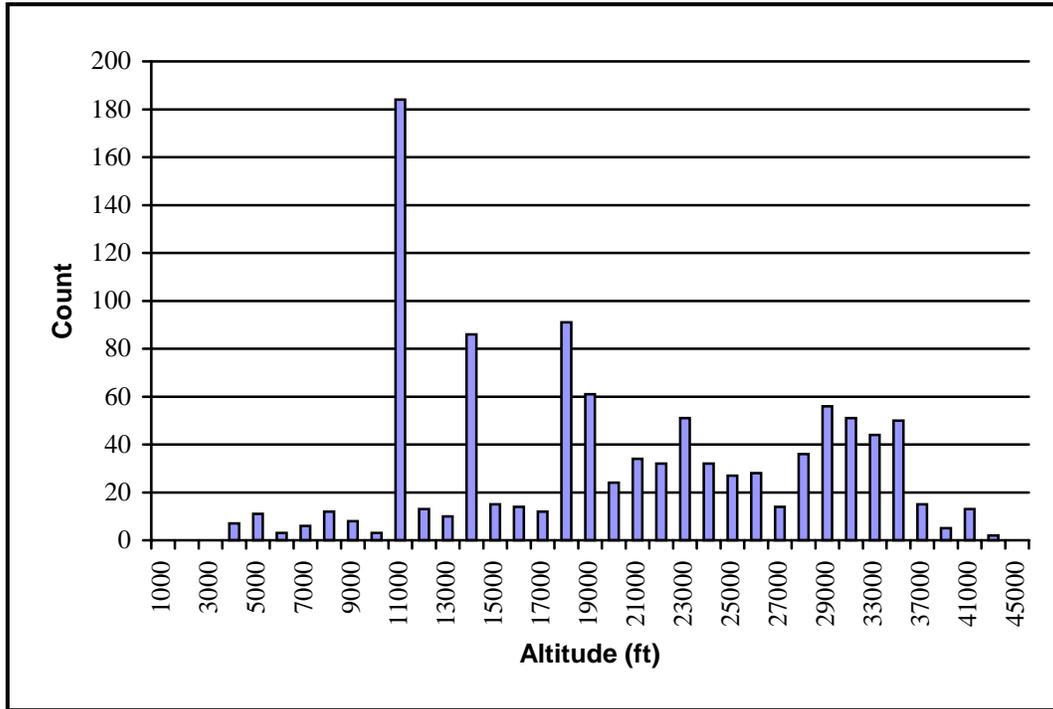


Figure 2: Airspace to Airspace Encounters by Altitude

### 5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

**Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts**

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	8	8	5	21
Cruise	3	22	26	51
Descend	3	3	9	15
Total	14	33	40	87

**Table 8: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts**

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	1	0	0	1
Cruise	1	0	0	1
Descend	7	0	0	7
Total	9	0	0	9

**Table 9: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles**

Vertical Phase	Count
Climb	15
Cruise	2
Descend	2
Total	19

## 6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

### 6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

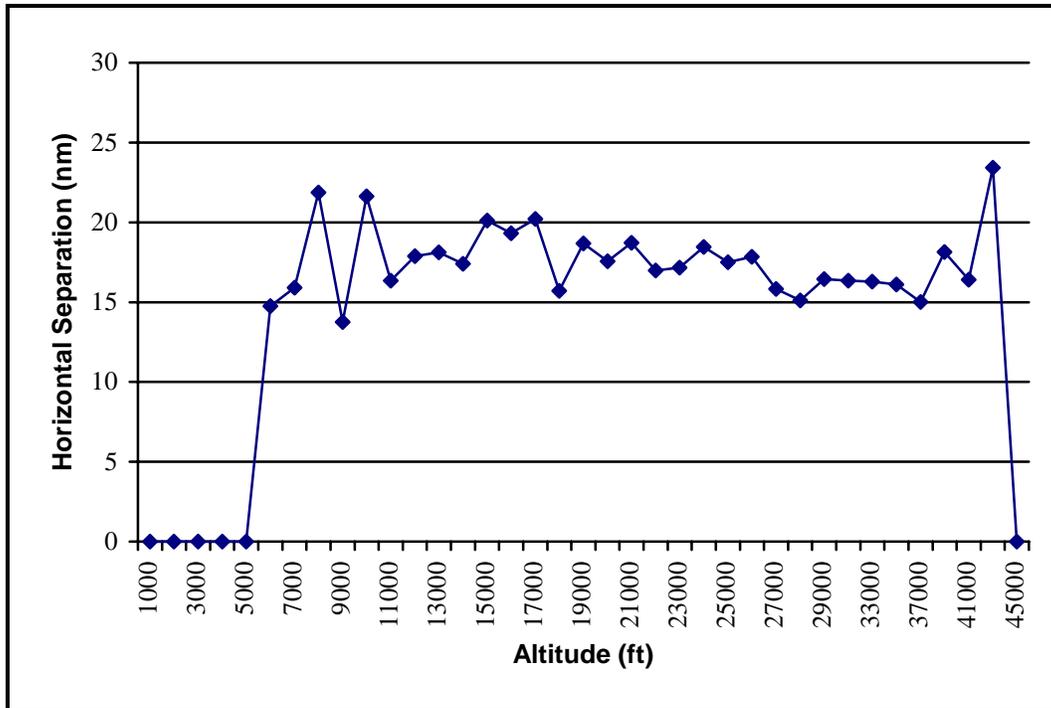


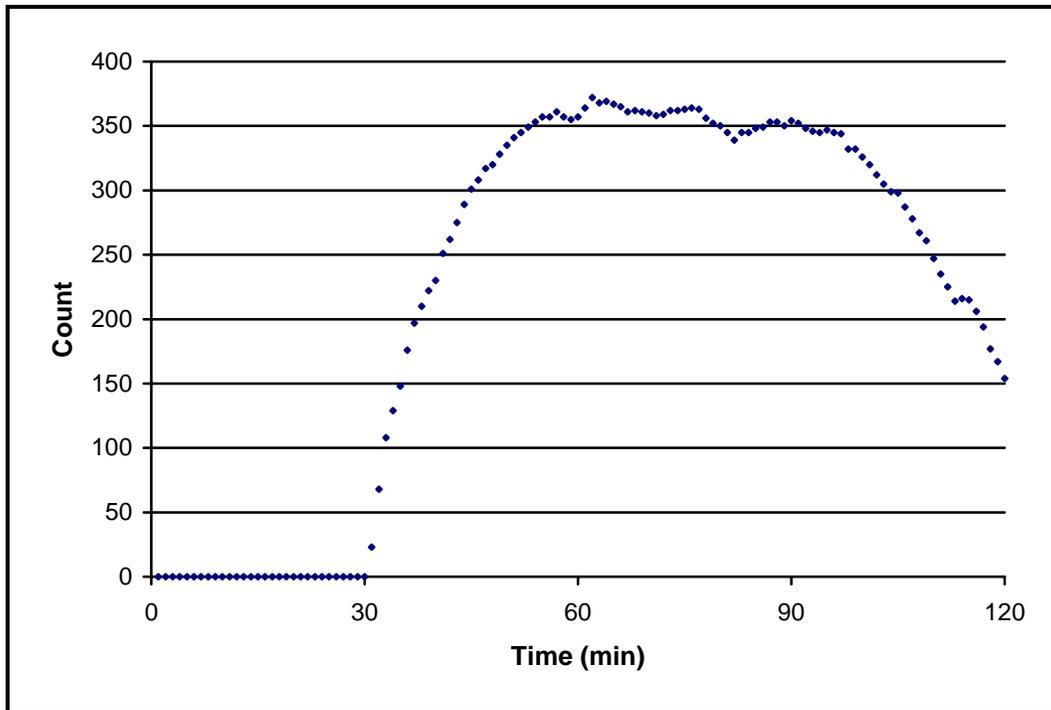
Figure 3: Average Horizontal Separation by Altitude for All Hours

## 6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

**Table 10: Statistics on Active Flights per Minute Increment**

Count Average	Standard Deviation	Maximum Count	Minimum Count
225.350	146.759	372	0



**Figure 4: Count of Active Flights per Minute Increment**

### 6.3 Flight Type and Sector Penetration

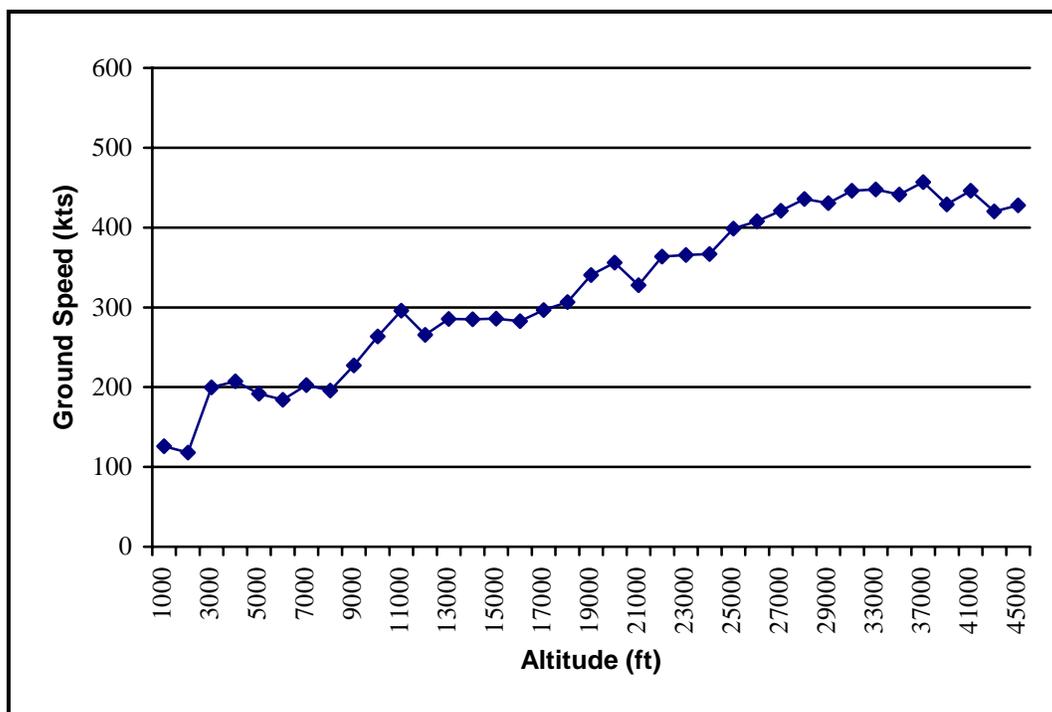
This section corresponds to Section 3.3.3 of Reference[1].

**Table 11: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type**

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	2.466	2.794	2.611	2.315	2.590
Average Time in Center (sec)	1212.880	1302.871	1192.820	1360.000	1240.103
Average Time in Sector (sec)	473.142	460.171	445.780	581.737	467.907
Percentage by Flight Type	21.804	23.858	43.721	10.502	100.000

### 6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.



**Figure 5: Average Ground Speed by Altitude for All Hours**

## 6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

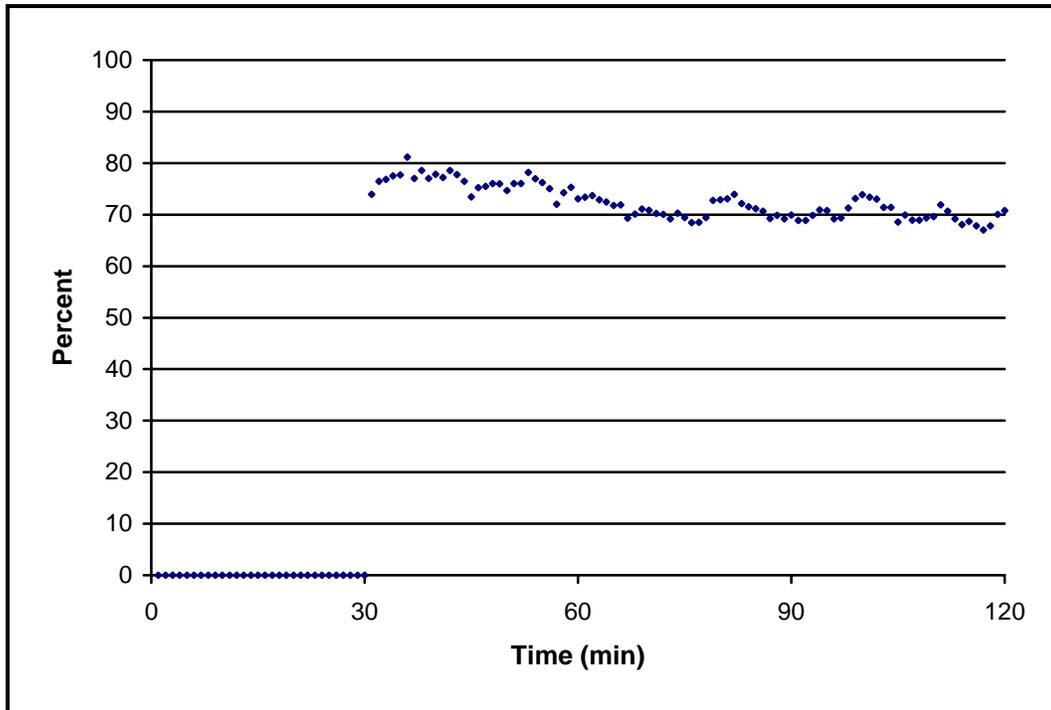


Figure 6: Percentage of Track Points in Center to APD Zone per Minute Increment

## 6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 12: Statistics on Interim Altitude Messages<sup>5</sup>

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
655	3.041	1.269	9	1

## 6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1]

Table 13: Statistics on Amendment Messages per Flight<sup>6</sup>

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
451	2.541	1.663	9	1

<sup>5</sup> Statistics on flights with interim altitude messages only

<sup>6</sup> Statistics on flights with flight plan amendments only

## 6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

**Table 14: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight**

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	5768	1315	7083
DES	4843	941	5784
LEV	1855	1020	2875
Total	12466	3276	15742

**Table 15: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase**

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	22.012	5.018	27.030
DES	18.482	3.591	22.073
LEV	7.079	3.893	10.972
Margin (%)	47.573	12.502	60.075

## 7 Aircraft Distributions

This sections provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

### 7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

**Table 16: Count by Aircraft Type**

Aircraft Type	Count	Percentage of Total
J	703	79.345
P	55	6.208
T	126	14.221
Unknown	2	0.226
Total	886	100.000

## 7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

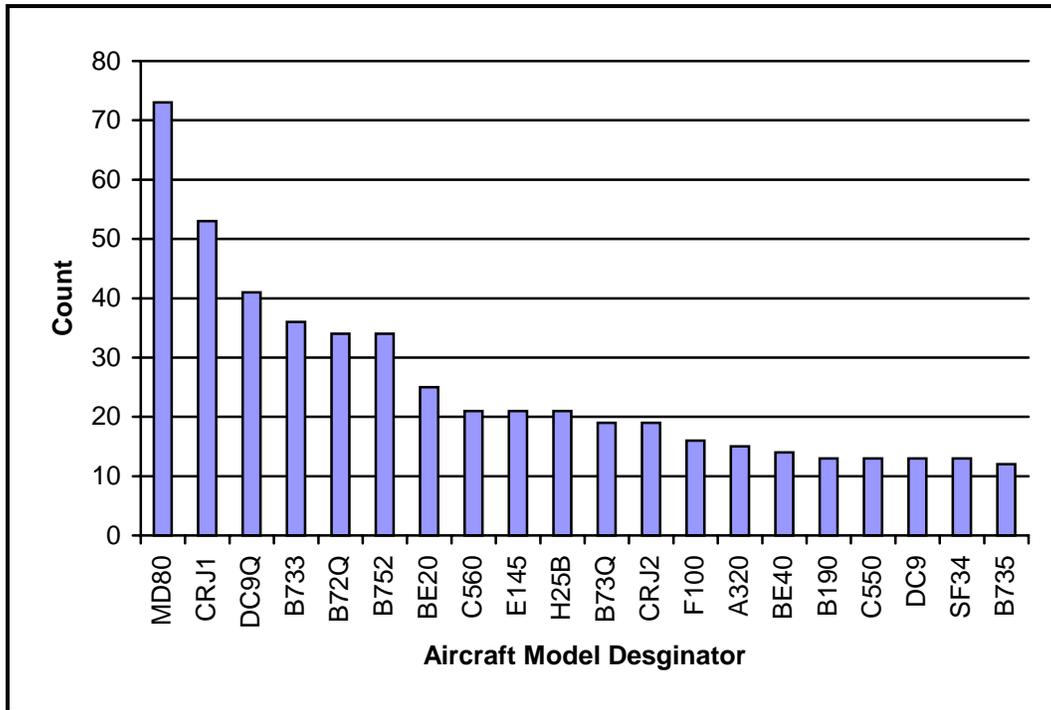


Figure 7: Count of Top Twenty Aircraft Models

### 7.3 Navigational Equipage

This section corresponds to Section 3.4.3 of Reference[1].

**Table 17: Count by Aircraft Navigational Equipage Type**

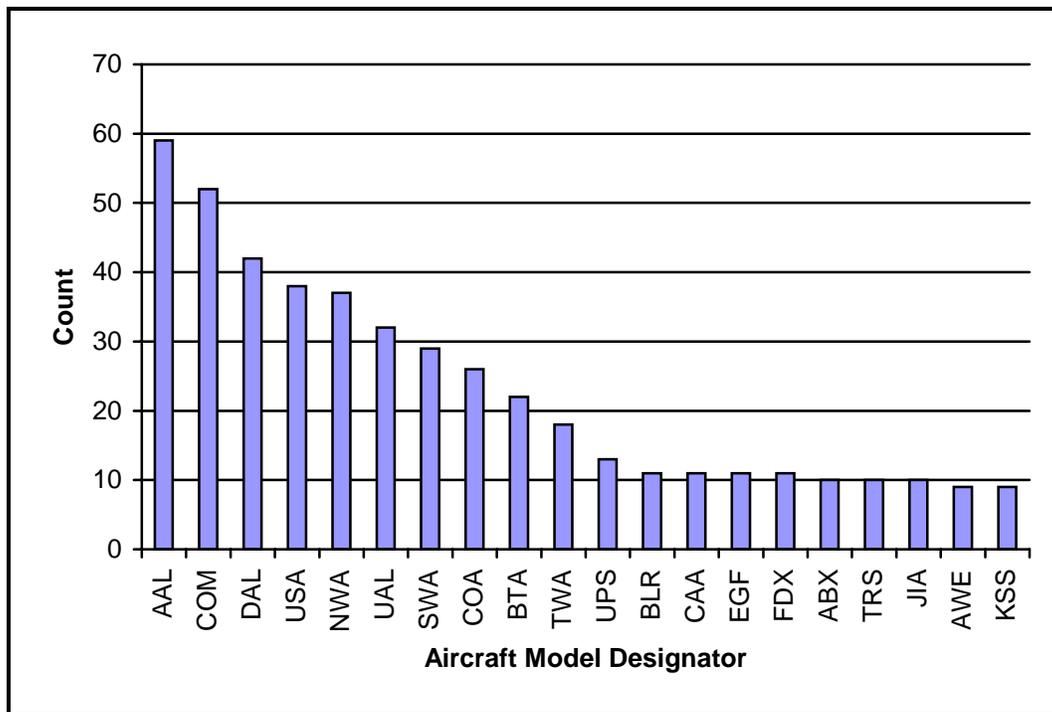
Nav. Equip. Designator	Count	Percentage of total
G	218	24.605
A	182	20.542
I	151	17.043
F	146	16.479
E	134	15.124
R	37	4.176
W	7	0.790
U	5	0.564
Q	4	0.451
B	1	0.113
Unknown	1	0.113
Total	886	100.000

## 7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

**Table 18: Count by Carrier Type**

Category	Count	Percentage of Total
Commercial	613	69.187
General Aviation	259	29.233
Other <sup>7</sup>	14	1.580
Total	886	100.000



**Figure 8: Count by Top Twenty Air Carriers**

<sup>7</sup> Includes military and aircraft with unrecognized designators

## 8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

### 8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

**Table 19: Statistics on Lateral Flight Plan Adherence by Altitude<sup>8</sup>**

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	14	36.831	11.014	19.173	6.194
18000	13	22.391	13.126	16.664	1.667
33000	43	53.283	13.048	26.287	7.287
45000	17	39.268	19.001	23.635	4.320
Total	87				

### 8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

**Table 20: Statistics on Vertical Flight Plan Adherence by Altitude<sup>9</sup>**

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	402	30000	322	5234.572	4001.631
45000	184	17100	634	3801.700	2219.207
Total	586				

<sup>8</sup> Statistics determined on tracks out of lateral adherence only.

<sup>9</sup> Statistics were determined on tracks out of vertical adherence only.

## Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

Table 21: Statistics on Aircraft Encounters by Altitude Interval for All Hours

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	0	0.000	0.000
5000	0	0.000	0.000
6000	2	14.747	12.733
7000	4	15.916	7.394
8000	1	21.868	0.000
9000	2	13.749	4.328
10000	1	21.620	0.000
11000	27	16.336	8.242
12000	22	17.889	7.777
13000	15	18.111	5.779
14000	37	17.399	7.345
15000	46	20.116	7.140
16000	62	19.306	7.082
17000	46	20.208	6.447
18000	44	15.704	7.947
19000	48	18.679	8.280
20000	18	17.557	6.952
21000	44	18.715	6.957
22000	48	16.977	8.144
23000	61	17.154	6.665
24000	59	18.459	6.840
25000	56	17.496	7.928
26000	53	17.847	7.391
27000	41	15.830	7.978
28000	79	15.106	7.997
29000	156	16.455	8.103
31000	305	16.344	7.900
33000	284	16.282	8.048
35000	217	16.113	8.054
37000	86	15.010	7.509
39000	16	18.144	8.011
41000	20	16.403	7.959

43000	1	23.422	0.000
45000	0	0.000	0.000
Total	1901		

## Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

Table 22: Statistics on Ground Speed by Altitude for All Hours

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	1	126.000	0.000
2000	7	118.023	52.414
3000	21	199.618	65.569
4000	105	207.330	44.653
5000	166	191.866	46.446
6000	251	184.317	58.093
7000	300	202.448	50.938
8000	355	195.559	54.982
9000	358	227.385	57.113
10000	374	263.552	64.382
11000	385	295.678	61.089
12000	388	265.590	69.441
13000	392	285.370	80.685
14000	396	284.853	69.129
15000	399	285.916	73.737
16000	401	282.525	78.259
17000	407	296.511	83.400
18000	408	306.603	72.948
19000	412	340.661	69.522
20000	400	356.163	73.355
21000	397	327.875	78.213
22000	402	363.758	81.992
23000	390	365.518	82.780
24000	387	366.675	80.104
25000	384	398.537	67.025
26000	383	407.977	66.303
27000	372	420.843	58.005
28000	376	435.672	44.697
29000	353	430.455	54.537
31000	331	446.130	40.495
33000	301	447.901	29.259
35000	225	441.410	27.956
37000	134	456.796	32.011
39000	71	428.852	45.109
41000	38	446.055	32.251
43000	13	420.203	24.574
45000	6	427.605	18.550

## Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

Table 23: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	0	1
	DES	0	0
	LEV	0	0
2000	ASC	2	5
	DES	0	0
	LEV	4	6
3000	ASC	7	8
	DES	5	4
	LEV	5	12
4000	ASC	17	20
	DES	54	33
	LEV	28	34
5000	ASC	17	18
	DES	76	81
	LEV	53	35
6000	ASC	26	28
	DES	113	104
	LEV	80	37
7000	ASC	38	33
	DES	132	114
	LEV	101	49
8000	ASC	51	41
	DES	174	118
	LEV	128	54
9000	ASC	32	22
	DES	172	100
	LEV	135	45
10000	ASC	50	34
	DES	197	92
	LEV	162	51
11000	ASC	65	28
	DES	227	66
	LEV	181	44
12000	ASC	30	13
	DES	218	44
	LEV	182	34

13000	ASC	20	12
	DES	223	40
	LEV	183	28
14000	ASC	14	8
	DES	230	37
	LEV	193	32
15000	ASC	30	17
	DES	228	30
	LEV	193	31
16000	ASC	39	11
	DES	234	22
	LEV	200	28
17000	ASC	27	12
	DES	234	29
	LEV	192	29
18000	ASC	34	25
	DES	239	34
	LEV	206	44
19000	ASC	37	15
	DES	236	25
	LEV	206	40
20000	ASC	34	17
	DES	229	31
	LEV	207	27
21000	ASC	37	22
	DES	230	28
	LEV	201	22
22000	ASC	43	19
	DES	229	27
	LEV	201	27
23000	ASC	51	23
	DES	225	31
	LEV	193	26
24000	ASC	86	22
	DES	221	19
	LEV	195	28
25000	ASC	48	18
	DES	218	20
	LEV	197	22
26000	ASC	40	16
	DES	219	28

	LEV	194	19
27000	ASC	51	11
	DES	211	21
	LEV	189	23
28000	ASC	108	37
	DES	215	31
	LEV	187	18
29000	ASC	156	66
	DES	205	22
	LEV	176	15
31000	ASC	143	80
	DES	186	29
	LEV	152	18
33000	ASC	190	115
	DES	161	20
	LEV	126	27
35000	ASC	143	99
	DES	113	18
	LEV	96	15
37000	ASC	88	56
	DES	57	6
	LEV	56	10
39000	ASC	51	37
	DES	35	4
	LEV	19	6
41000	ASC	33	22
	DES	15	3
	LEV	15	3
43000	ASC	11	8
	DES	6	4
	LEV	4	2
45000	ASC	6	1
	DES	1	0
	LEV	3	0

## Appendix D: Supplement to Section 7.2 - Aircraft Models

**Table 24: Count and Percentage of Aircraft by Model Type**

Model Type	Aircraft Count	Percent of Total
MD80	73	8.239
CRJ1	53	5.982
DC9Q	41	4.628
B733	36	4.063
B72Q	34	3.837
B752	34	3.837
BE20	25	2.822
C560	21	2.370
E145	21	2.370
H25B	21	2.370
B73Q	19	2.144
CRJ2	19	2.144
F100	16	1.806
A320	15	1.693
BE40	14	1.580
B190	13	1.467
C550	13	1.467
DC9	13	1.467
SF34	13	1.467
B735	12	1.354
B763	12	1.354
D328	11	1.242
E135	11	1.242
B737	10	1.129
A306	9	1.016
BE10	9	1.016
BE58	9	1.016
FA20	9	1.016
GLF2	9	1.016
A319	7	0.790
B722	7	0.790
B762	7	0.790
BA46	7	0.790
BE55	7	0.790
C650	7	0.790
CL60	7	0.790
MD80	73	8.239

GLF4	7	0.790
LJ31	7	0.790
LJ35	7	0.790
SBR1	7	0.790
B350	6	0.677
B738	6	0.677
B772	6	0.677
BE36	6	0.677
BE9L	6	0.677
C525	6	0.677
F2TH	6	0.677
LJ24	6	0.677
LJ25	6	0.677
BE30	5	0.564
C310	5	0.564
E120	5	0.564
FA50	5	0.564
JS41	5	0.564
WW24	5	0.564
C500	4	0.451
AC90	3	0.339
B712	3	0.339
BE9T	3	0.339
C182	3	0.339
C210	3	0.339
C501	3	0.339
C750	3	0.339
CARJ	3	0.339
DC10	3	0.339
DC87	3	0.339
GLF3	3	0.339
H25	3	0.339
LJ60	3	0.339
MU30	3	0.339
PAY2	3	0.339
A310	2	0.226
ASTR	2	0.226
AT43	2	0.226
B734	2	0.226
B741	2	0.226
B744	2	0.226
BE35	2	0.226

C130	2	0.226
C177	2	0.226
C340	2	0.226
C421	2	0.226
C56X	2	0.226
DC8Q	2	0.226
DH8A	2	0.226
F16	2	0.226
H25C	2	0.226
LJ45	2	0.226
MD11	2	0.226
MD90	2	0.226
PA31	2	0.226
SW4	2	0.226
B721	1	0.113
B732	1	0.113
B767	1	0.113
BE23	1	0.113
BE60	1	0.113
BE9	1	0.113
BE90	1	0.113
C135	1	0.113
C141	1	0.113
C172	1	0.113
C206	1	0.113
C414	1	0.113
D382	1	0.113
DC3	1	0.113
DH8B	1	0.113
DH8C	1	0.113
F15	1	0.113
F28	1	0.113
F70	1	0.113
GLF5	1	0.113
H141	1	0.113
HS25	1	0.113
JS31	1	0.113
JS32	1	0.113
K35E	1	0.113
L101	1	0.113
LR24	1	0.113
M20P	1	0.113

MO21	1	0.113
MU2	1	0.113
P210	1	0.113
PA27	1	0.113
PA28	1	0.113
PA34	1	0.113
PAY1	1	0.113
PAY3	1	0.113
SW3	1	0.113
TBM7	1	0.113
Unk	1	0.113
Total	886	100.000